

crowding. While impellers are used to compartmentalize the animals, mechanically or manually operated gates are used to move the animals onto the conveyors. Surgically anaesthetized animals, or killed swine, are moved out of the tunnels by the same continuous conveyors that moved them into and through the carbon dioxide gas.

(ii) Flow of animals into and through the carbon dioxide chamber is dependent on one operator. The operation or stoppage of the conveyor is entirely dependent upon this operator. It is necessary that he be skilled, attentive, and aware of his responsibility. Overdosages and death of animals can be brought about by carelessness of this individual.

(2) *Special requirements for gas chamber and auxiliary equipment.* The ability of anesthetizing equipment to perform with maximum efficiency is dependent on its proper design and efficient mechanical operation. Pathways, compartments, gas chambers, and all other equipment used must be designed to accommodate properly the species of animals being anesthetized. They shall be free from pain-producing restraining devices. Injury of animals must be prevented by the elimination of sharp projections or exposed wheels or gears. There shall be no unnecessary holes, spaces or openings where feet or legs of animals may be injured. Impellers or other devices designed to mechanically move or drive animals or otherwise keep them in motion or compartmentalized shall be constructed of flexible or well padded rigid material. Power activated gates designed for constant flow of animals to anesthetizing equipment shall be so fabricated that they will not cause injury. All equipment involved in anesthetizing animals shall be maintained in good repair.

(3) *Gas.* Maintenance of a uniform carbon dioxide concentration and distribution in the anesthesia chamber is a vital aspect of producing surgical anesthesia. This may be assured by reasonably accurate instruments which sample and analyze carbon dioxide gas concentration within the chamber throughout anesthetizing operations. Gas concentration shall be maintained uniform so that the degree of anesthesia in exposed animals will be con-

stant. Carbon dioxide gas supplied to anesthesia chambers may be from controlled reduction of solid carbon dioxide or from a controlled liquid source. In either case the carbon dioxide shall be supplied at a rate sufficient to anesthetize adequately and uniformly the number of animals passing through the chamber. Sampling of gas for analysis shall be made from a representative place or places within the chamber and on a continuing basis. Gas concentrations and exposure time shall be graphically recorded throughout each day's operation. Neither carbon dioxide nor atmospheric air used in the anesthesia chambers shall contain noxious or irritating gases. Each day before equipment is used for anesthetizing animals, proper care shall be taken to mix adequately the gas and air within the chamber. All gas producing and control equipment shall be maintained in good repair and all indicators, instruments, and measuring devices must be available for inspection by Program inspectors during anesthetizing operations and at other times. An exhaust system must be provided so that, in case of equipment failure, non-uniform carbon dioxide concentrations in the gas tunnel or contamination of the ambient air of the establishment will be prevented.

[44 FR 68813, Nov. 30, 1979, as amended at 59 FR 21640, Apr. 26, 1994]

§313.15 Mechanical; captive bolt.

The slaughtering of sheep, swine, goats, calves, cattle, horses, mules, and other equines by using captive bolt stunners and the handling in connection therewith, in compliance with the provisions contained in this section, are hereby designated and approved as humane methods of slaughtering and handling of such animals under the Act.

(a) *Application of stunners, required effect; handling.* (1) The captive bolt stunners shall be applied to the livestock in accordance with this section so as to produce immediate unconsciousness in the animals before they are shackled, hoisted, thrown, cast, or cut. The animals shall be stunned in such a manner that they will be rendered unconscious with a minimum of excitement and discomfort.

(2) The driving of the animals to the stunning area shall be done with a minimum of excitement and discomfort to the animals. Delivery of calm animals to the stunning areas is essential since accurate placement of stunning equipment is difficult on nervous or injured animals. Among other things, this requires that, in driving animals to the stunning areas, electrical equipment be used as little as possible and with the lowest effective voltage.

(3) Immediately after the stunning blow is delivered the animals shall be in a state of complete unconsciousness and remain in this condition throughout shackling, sticking and bleeding.

(b) *Facilities and procedures*—(1) *General requirements for stunning facilities; operator.* (i) Acceptable captive bolt stunning instruments may be either skull penetrating or nonpenetrating. The latter type is also described as a concussion or mushroom type stunner. Penetrating instruments on detonation deliver bolts of varying diameters and lengths through the skull and into the brain. Unconsciousness is produced immediately by physical brain destruction and a combination of changes in intracranial pressure and acceleration concussion. Nonpenetrating or mushroom stunners on detonation deliver a bolt with a flattened circular head against the external surface of the animal's head over the brain. Diameter of the striking surface of the stunner may vary as conditions require. Unconsciousness is produced immediately by a combination of acceleration concussion and changes in intracranial pressures. A combination instrument utilizing both penetrating and nonpenetrating principles is acceptable. Energizing of instruments may be accomplished by detonation of measured charges of gunpowder or accurately controlled compressed air. Captive bolts shall be of such size and design that, when properly positioned and activated, immediate unconsciousness is produced.

(ii) To assure uniform unconsciousness with every blow, compressed air devices must be equipped to deliver the necessary constant air pressure and must have accurate, constantly operating air pressure gauges. Gauges must be easily read and conveniently located

for use by the stunning operator and the inspector. For purposes of protecting employees, inspectors, and others, it is desirable that any stunning device be equipped with safety features to prevent injuries from accidental discharge. Stunning instruments must be maintained in good repair.

(iii) The stunning area shall be so designed and constructed as to limit the free movements of animals sufficiently to allow the operator to locate the stunning blow with a high degree of accuracy. All chutes, alleys, gates and restraining mechanisms between and including holding pens and stunning areas shall be free from pain-producing features such as exposed bolt ends, loose boards, splintered or broken planking, and protruding sharp metal of any kind. There shall be no unnecessary holes or other openings where feet or legs of animals may be injured. Overhead drop gates shall be suitably covered on the bottom edge to prevent injury on contact with animals. Roughened or cleated cement shall be used as flooring in chutes leading to stunning areas to reduce falls of animals. Chutes, alleys, and stunning areas shall be so designed that they will comfortably accommodate the kinds of animals to be stunned.

(iv) The stunning operation is an exacting procedure and requires a well-trained and experienced operator. He must be able to accurately place the stunning instrument to produce immediate unconsciousness. He must use the correct detonating charge with regard to kind, breed, size, age, and sex of the animal to produce the desired results.

(2) *Special requirements.* Choice of instrument and force required to produce immediate unconsciousness varies, depending on kind, breed, size, age, and sex of the animal. Young swine, lambs, and calves usually require less stunning force than mature animals of the same kind. Bulls, rams, and boars usually require skull penetration to produce immediate unconsciousness. Charges suitable for smaller kinds of livestock such as swine or for young animals are not acceptably interchanged for use on larger kinds or older livestock, respectively.